

## Activity 2

### The Earth-Moon System

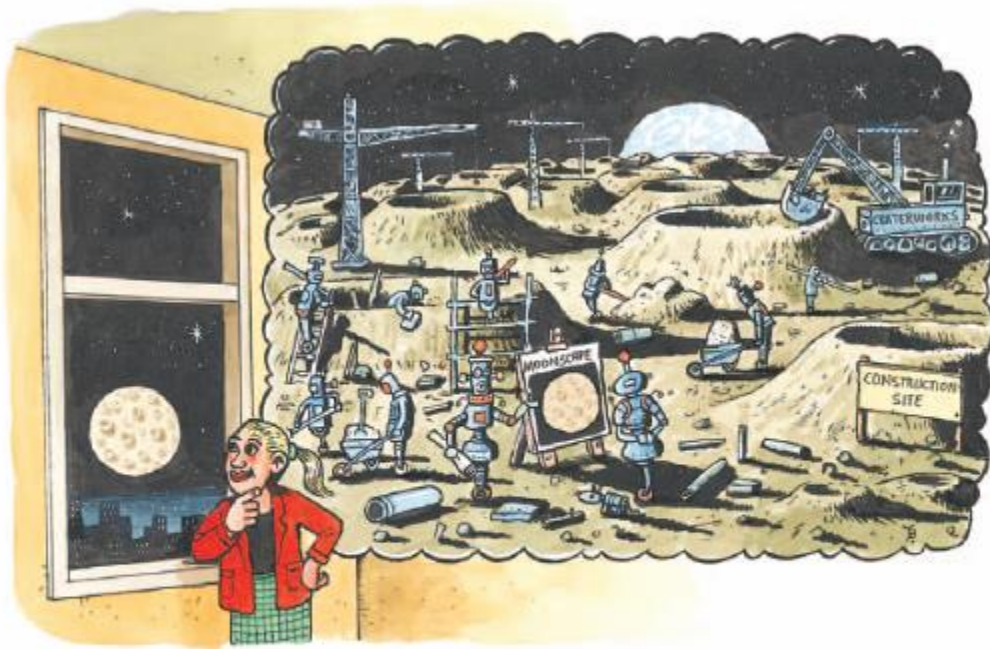
## Think About It

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- What happened to make the moon look the way it does?
- How did the moon form?
- How does the moon affect the Earth?



## WHAT DO YOU THINK?

## Activity 2

### Investigate Part C

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3a. What relationship exists between the highest high tides and phases of the moon?

*The relationship that exists between the highest high tides and phases of the moon is during the highest high tides, the moon phase is \_\_\_\_\_ .*

3b. What relationship exists between lowest high tides and phases of the moon?

*The relationship that exists between the lowest high tides and phases of the moon is during the lowest high tides, the moon phase is \_\_\_\_\_ .*

4a. What relationship exists between highest low tides and phases of the moon?

*The relationship that exists between the highest low tides and phases of the moon is during the highest low tides, the moon phase is \_\_\_\_\_ .*









4b. What relationship exists between the lowest low tides and phases of the moon?

*The relationship that exists between the lowest low tides and phases of the moon is*

during the lowest low tides, the moon phase is \_\_\_\_\_ .

5. Summarize your ideas about how the moon affects the tide.

The moon affects the tides because during A \_\_\_\_\_ moon, the high tides are \_\_\_\_\_ and the \_\_\_\_\_ tides are \_\_\_\_\_. During a \_\_\_\_\_ moon, the high tides are \_\_\_\_\_ and low tides are \_\_\_\_\_ .

Table 1 Heights of High and Low Tides in Five Coastal Locations during January 2001 (All heights are in feet.)													
			Breakwater, Delaware		Savannah, Georgia		Portland, Maine		Cape Hatteras, North Carolina		New London, Connecticut		
Date	Moon Phase	Moon Phase	High	Low	High	Low	High	Low	High	Low	High	Low	
1/3/01	First Quarter		2	3.6	0.2	7.3	0.5	8.5	1	2.6	0.2	2.4	0.3
1/6/01	Waxing Gibbous		3	4.5	0	8.2	0.5	9.7	0.1	3.4	-0.4	3	-0.2
1/10/01	Full Moon		4	5.6	-0.9	9.4	-1.5	11.6	-1.9	4.2	-0.8	3.5	-0.7
1/13/01	Waning Gibbous		3	5.1	-0.7	8.8	-0.9	11	-1.4	3.7	-0.6	3	-0.5
1/16/01	Last Quarter		2	4.1	-0.1	7.9	-0.2	9.7	0.1	3	-0.2	2.7	0
1/20/01	Waning Crescent		1	4.3	0.1	7.3	0.2	9.4	0.2	3.2	0	2.8	0
1/24/01	New Moon		0	4.6	0	8.1	-0.1	9.7	-0.1	3.3	-0.1	2.8	-0.1
1/30/01	Waxing Crescent		1	3.7	0.1	7.4	0.1	8.7	0.6	2.6	0	2.4	0.2

## Activity 2

### Digging Deeper

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Moon's appearance

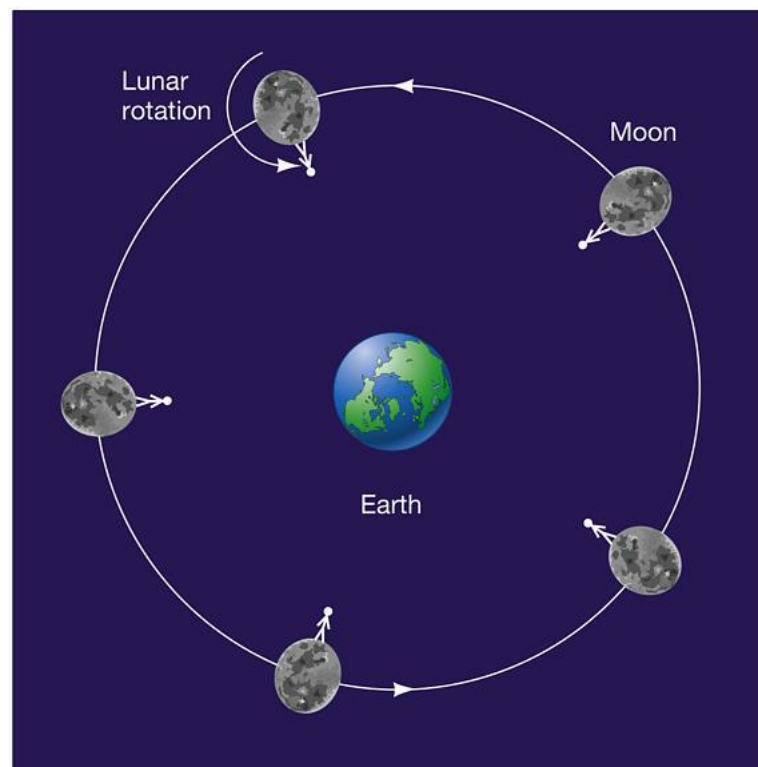
the moon's appearance changes due to its orbit around the Earth

27.3 days

the amount of time it takes the moon to:

1. rotate once on its axis
2. orbit the earth one time

The moon's rotation and orbit take the same amount of time, so the same side of the moon always faces the Earth



<http://www.webassign.net/fkastro9/animations/Animation03-02.htm>

[http://www.wwnorton.com/college/astronomy/studyspace/animations/moon\\_orbit.htm](http://www.wwnorton.com/college/astronomy/studyspace/animations/moon_orbit.htm)

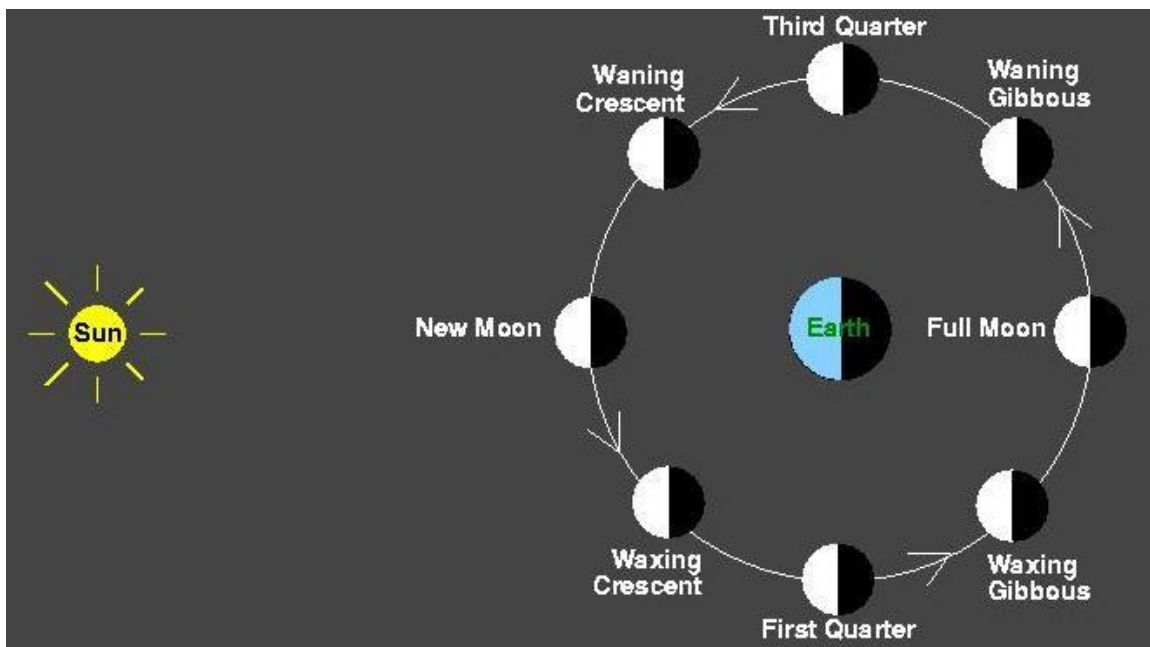
The moon shines

because it reflects sunlight

### Moon phases

the changing appearance of the moon as seen from Earth

The phase depends on the positions of the Earth, moon and sun



### New moon

when the lighted half of the moon is facing the sun and the dark side faces Earth

This happens when the moon is between Earth and the sun



After the new moon, more of the moon's lighted side can be seen

### Waxing

moon phases when more of the moon's lighted side becomes visible each night

 light is on the right side of the moon

Waxing crescent

a thin slice that can be seen about 24 hours after a new moon



First quarter



waxing phase when half of the  
lighted side of the moon is visible



Waxing gibbous

when more than one half of the  
moon's lighted surface is visible



## **Full moon**


occurs when all of the moon's surface facing Earth is lit up



After a full moon, less of the moon's lighted surface can be seen

## **Waning**

moon phases when less of the moon's light can be seen each night

 light is on the left side of the moon

Waning gibbous

begins just after a full moon





Third quarter

waning phase when only half of the lighted side of the moon can be seen



Waning crescent

occurs just before another new moon



[http://upload.wikimedia.org/wikipedia/commons/8/86/Lunar\\_libration\\_with\\_phase\\_Oct\\_2007.gif](http://upload.wikimedia.org/wikipedia/commons/8/86/Lunar_libration_with_phase_Oct_2007.gif)

<http://media-2.web.britannica.com/eb-media/43/78643-004-D17E6B79.gif>

29.5 days

the amount of time it takes for the moon to complete its cycle of phases

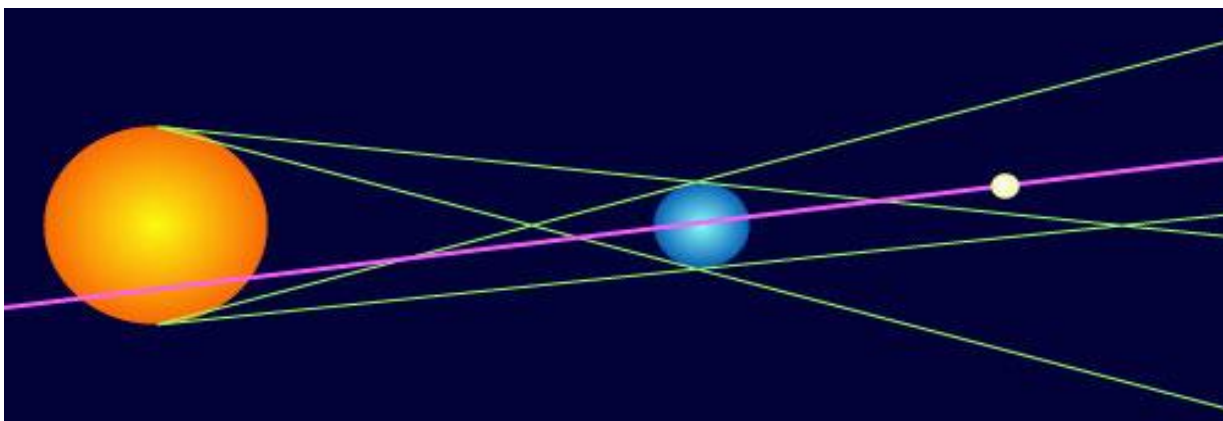
Solar and lunar eclipses

are caused by the orbit of the moon around the Earth

They occur when the moon or the Earth temporarily blocks the sunlight reaching the other

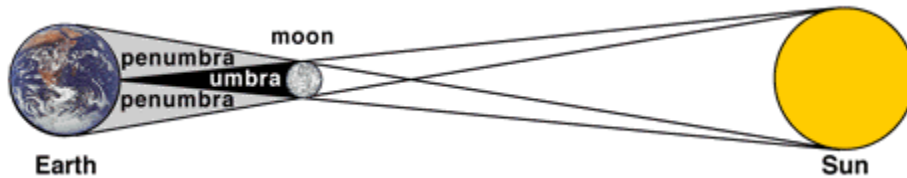
Can only take place when the Earth, moon and sun are lined up perfectly

This only happens a few times a year because the moon's orbit is usually higher than Earth's orbit around the sun



## Solar eclipse

when the moon moves directly between the sun and Earth and casts its shadow over part of the Earth



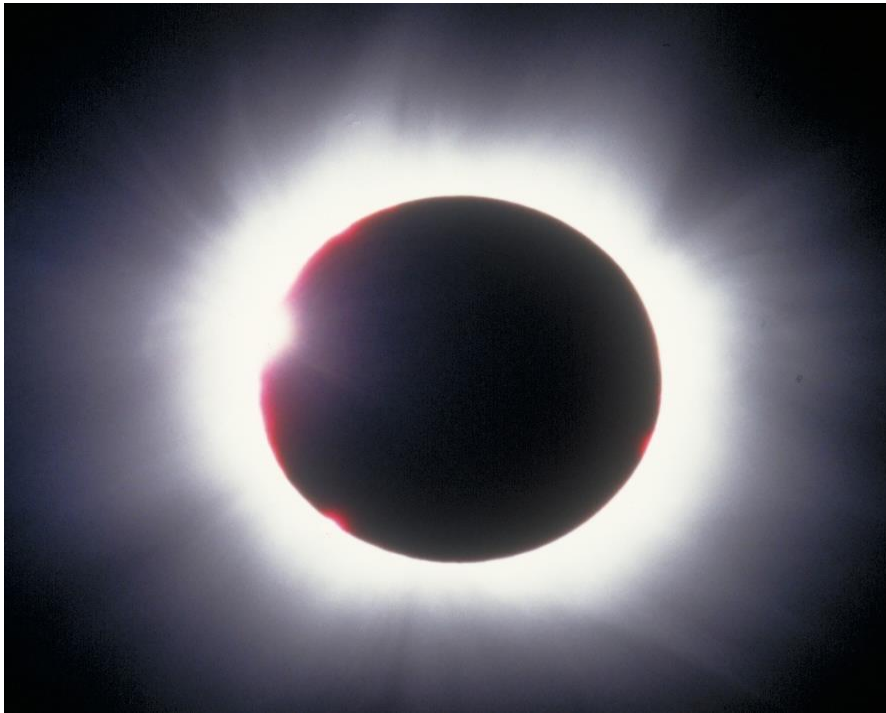
Umbra

the darkest part of the moon's shadow

People standing in the umbra see a total solar eclipse



<http://www.ssec.wisc.edu/media/spotlight/eclipse/>



[http://www.williams.edu/Astronomy/eclipse/eclipse2001/2001total/movies\\_and\\_animations/full\\_animation.html](http://www.williams.edu/Astronomy/eclipse/eclipse2001/2001total/movies_and_animations/full_animation.html)

[http://www.math.nus.edu.sg/aslaksen/gem-projects/hm/0304-1-26-eclipse\\_animation.swf](http://www.math.nus.edu.sg/aslaksen/gem-projects/hm/0304-1-26-eclipse_animation.swf)

Penumbra

a lighter shadow that surrounds the umbra

People standing in the penumbra see a partial solar eclipse



[http://www.classzone.com/books/earth\\_science/terc/content/visualizations/es2505/es2505page01.cfm](http://www.classzone.com/books/earth_science/terc/content/visualizations/es2505/es2505page01.cfm)

### **Lunar eclipse**

when the Earth moves in between the moon and the sun and casts its shadow on the moon

Sometimes sunlight bent through Earth's atmosphere causes the eclipsed moon to appear red



Anyone on the nighttime side of the Earth can see a lunar eclipse

[http://www.classzone.com/books/earth\\_science/terc/content/visualizations/es2504/es2504page01.cfm?chapter\\_no=visualization](http://www.classzone.com/books/earth_science/terc/content/visualizations/es2504/es2504page01.cfm?chapter_no=visualization)

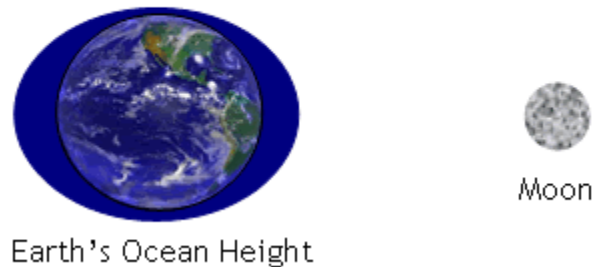
Tides

the rise and fall in sea level

They are caused by the gravitational pull of the moon and sun

This force stretches the water, creating two bulges on Earth's surface

### **Tidal Bulge**



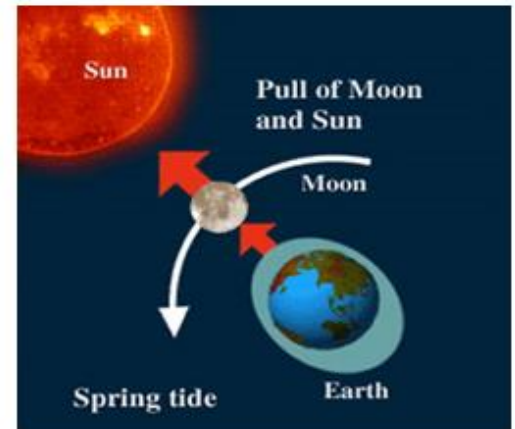
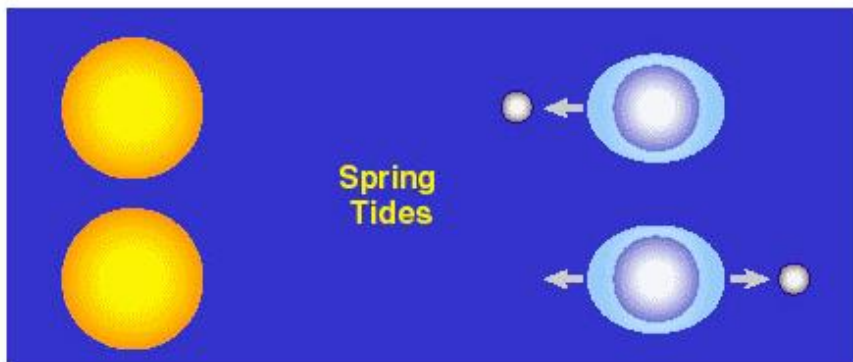
[http://serc.carleton.edu/images/NAGTWorkshops/visualize/04/tida\\_NOAA.gif](http://serc.carleton.edu/images/NAGTWorkshops/visualize/04/tida_NOAA.gif)

### **Spring tide**

the high tides are higher than usual, and the low tides are lower than usual

Occurs when the Earth, moon and sun are in a straight line

 new moon; full moon



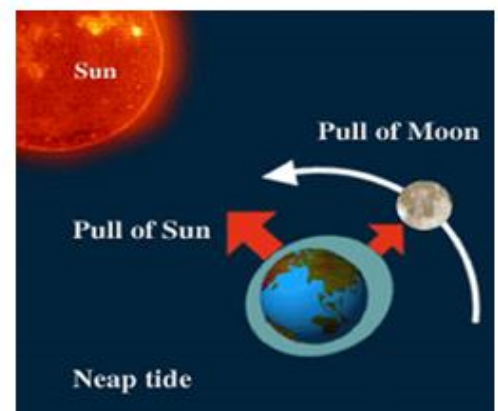
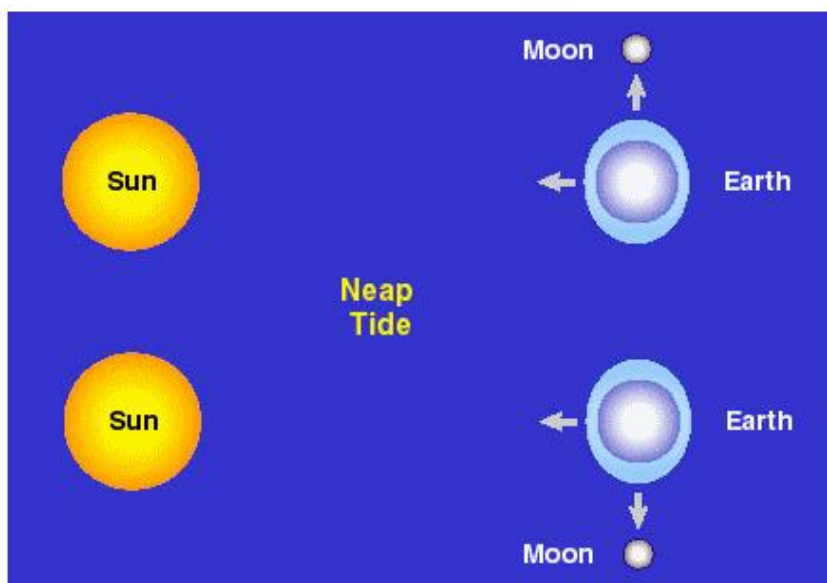
The moon is in the same direction as the sun, so their pull of gravity is added together

### Neap tide

high tides are lower than usual and low tides are higher than usual

When the lines between the Earth, moon and sun make a right angle

→ first quarter moon;  
third quarter moon



The gravitational pulls of the sun and moon work against each other

Formation of the moon

an object the size of Mars collided with early Earth

This collision shattered the early Earth, causing a ring of debris around what was left of our planet

The dust and debris began sticking together and eventually formed our moon



<http://www.pbs.org/wgbh/nova/tothemoon/origins2.html>

<http://www.space.com/18108-moon-made-by-colossal-collision-with-young-earth-video.html>

<http://sservi.nasa.gov/articles/video-evolution-of-the-moon/>



## Activity 2

### Check Your Understanding

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1. How did the moon likely form?
  
2. Describe the relative positions of the Earth, the moon, and the sun for a spring tide and for a neap tide.
  
3. What is the relationship between eclipses and phases of the moon?